Zootaxa 4317 (1): 179–184
http://www.mapress.com/j/zt/

Article

ISSN 1175-5326 (print edition)
ZOOTAXA
ISSN 1175-5334 (online edition)

https://doi.org/10.11646/zootaxa.4317.1.10
http://zoobank.org/urn:lsid:zoobank.org:pub:88FA0944-D3CF-4A7D-B8FB-BAA6A3A76744

What really hampers taxonomy and conservation? A riposte to Garnett and Christidis (2017)

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Abstract

Responding to purported taxonomic anarchy, in an article published in the widely read journal *Nature*, Garnett & Christidis (2017) [hereafter GC] opined on the need for "*standardized global species lists*", at the behest of conservationists, and proposed the construction of a judicial committee to "*restrict ... freedom of taxonomic action*" and promote taxonomic stability. Here we reflect on this perspective and contest that the view of GC conflicts with some basic and indisputable principles underpinning the philosophy of science, most notably: it must be free. They appear to believe that taxonomic revisions should be based on political, economic and conservation concerns, and they treat species as fixed real entities, instead of refutable scientific hypotheses. In addition to such theoretical misconceptions, GC did not consider important practical aspects of what they term taxonomic anarchy, most significantly the participation of conservationists as authors of taxonomic works, and the importance of alternative management units, a well-established discussion in conservation biology.

Key words: Taxonomy, freedom, science, philosophy, conservation

Introduction

The journal *Nature* has historically published important contributions on biodiversity, evolution and taxonomy, the science behind the classification of living organisms. One such was Bremer *et al*. (1990) who wrote persuasively: "*Taxonomists should pursue their scientific venture and stop worrying about instability in classification. Taxonomy is not a service function for labeling organisms, but a science of its own, dealing with variation, relationships and phylogeny*" (see also Dubois 1998; Carvalho *et al*. 2007). These views are aligned with modern concepts of science and freedom of expression. However, the opinion of Garnett & Christidis (2017) [GC hereafter] expressed in an article published in the same journal appears to blatantly contradict these principles, by arguing for "*standardized global species lists*", supposedly at the behest of conservationists, and proposing a structure to "*restrict the freedom of taxonomic action*" and promote taxonomic stability. Interestingly, Bremer *et al*. (1990) had also stated: "*to establish some international peer-review system to approve or reject proposed modifications overlooks the benefits of change in taxonomy*".

Accepted by A. Minelli: 19 Jul. 2017; published: 1 Sept. 2017

Here we reflect on these perspectives following two necessary lines of thought: a theoretical one, where we concentrate on different philosophical aspects of their propositions and statements; and a practical approach, where we analyse, based on GC's examples, the consistency of their statements as true representation of the current taxonomic universe.

Theoretical perspective

The dispute between those who need, for practical ends, stable lists of existing species and those who classify and catalogue life is old (*e.g*. Crisp & Fogg 1988) and motivated Bremer *et al*. (1990) to write in defence of taxonomic work. Twenty-seven years later GC (but see also Thiele & Yeates 2002; Godfray 2007) brought back to the widely read journal *Nature* a pragmatic view of the function of taxonomy, demonstrating that the debate is far from over and revealing the necessity of more profound reflections and clarification.

GC commence by stating that "*The assumption that species are fixed entities underpins every international agreement on biodiversity conservation, all national environmental legislation …[etc.]*". The statement that species are "fixed entities" goes back to Linnaeus (*vide* Zachos 2016: 30) and is unacceptable from a modern evolutionary viewpoint. Furthermore, this belief goes against the very widespread conception of science whose aim is not a search for definitive or 'fixed truth', but to produce rational and testable hypotheses, and the replacement via refutation of once-adopted hypotheses by better ones until they are in their turn subject to modification or rejection. Thus is science and, particularly in taxonomy, stability is ignorance, as well expressed by Gaffney (1979), Dominguez & Wheeler (1997) and Dubois (2005).

Species are scientific hypotheses and their definition and limits should change whenever scientists judge this necessary. We will refrain from discussing whether species hypotheses refer to real entities or not (see Dubois 2007; Raposo & Kirwan 2017), because under either perspective (existing or non-existent), they represent hypotheses and consequently are not static.

Some of the consequences of such a misguided notion of species and the role played by scientific hypotheses are better understood by examining GC's statement that "*Paradoxically, finer splitting could also make certain species more vulnerable*". To claim that finer splitting renders species more vulnerable is inconsistent with facts and logic. From the perspective that a species is a human intellectual construct, it can only be endangered once it has gained existence through formal taxonomic procedures, such as description or validation. If species should be regarded as pre-existing real entities, the splitting action becomes even more important as it equips the conservation community with the appropriate knowledge to take specific measures to protect these entities. On the other hand, ignorance or omission leads to real risk of extinction simply because it is impossible to preserve what is unknown.

Another common misunderstanding is their apparent belief that taxonomists should be driven by conservation and economic goals, and not otherwise. Although we are sensitive to some of these consequences, at least in theory, a better understanding of the natural world will always positively impact conservation policy. The few examples mentioned by GC attest to this and not to the contrary as they purport. For example, according to GC, a taxonomic revision of the "*central Asian argali wild sheep (*Ovis ammon*), turned one species into nine, and overnight Kazakhstan had five mountain sheep species in need of protection, not just one*". Apparently, following this taxonomic revision we discovered that the group's conservation was much more problematic than previously thought. This line of reasoning provides response to virtually all of the examples presented by GC. There is no option but to find the hypothesis that best approaches our conception of reality under present knowledge.

More seriously, GC confound science and politics stating that the "*community's failure to govern taxonomy threatens the effectiveness of global efforts to halt biodiversity loss, damages the credibility of science and is expensive to society.*" Following this line of reasoning, the authors complain that "*a single taxonomic paper can affect whole conservation programmes, tourist enterprises and employment opportunities.*" But should taxonomists try to predict future economic or political disputes when reviewing taxonomy? Such considerations would discredit taxonomy as a scientific enterprise. The idea that a taxonomist should not validate species that might be endangered or should not refute as inadequate hypotheses insufficiently robust species or, much less to create a "judicial committee" to analyse the political impacts of taxonomic works before accepting them is scientifically unacceptable and ethically reprehensible. Such a body would transform taxonomy into a merely political tool for

guiding economic decisions that are not necessarily aligned with species preservation policies. The authors refer to the International Union of Microbiological Societies (IUMS) as an example of success, but criticise it because of the statement "*Nothing in this Code may be construed to restrict the freedom of taxonomic action*." GC are apparently impervious to what lies behind such an important ruling, the only really indisputable truth in science: it must be free.

The authors also attest that the International Union of Biological Sciences (IUBS) should restrict the freedom of taxonomists. This is anti-scientific and would result in science "losing its soul" with significant negative results, as demonstrated by Trofim Lysenko's rejection of Mendelian genetic inheritance theory, which gained the support of Joseph Stalin, described in Leone's (1952: 379) words thus "*Science cannot long remain unfettered in a social system which seeks to exercise strict control over the whole spiritual and intellectual life of a nation. The correctness of a scientific theory can never be adjudged by its readiness to give the answers desired by political leadership*" (see also Hołynski 2017). In this sense, taxonomists should struggle to maintain their "freedom of taxonomic thought or action", as noted in the preamble to the *International Code of Zoological Nomenclature* (Anonymous 1999, hereafter 'the *Code*'; see also Minelli 2000).

Practical perspective: who is really demanding stability?

The main argument motivating GC is the putative demand for stability by conservationists. To illustrate this, they provide a diagram demonstrating supposedly anarchic avian taxonomy. At this point, a detailed look at the very specific case reported by the authors becomes important.

Among the taxon Aves, the most recently published world checklist (del Hoyo & Collar 2014, 2016) recognises 4,372 species of non-passerines and 6,592 species of passerines, versus totals of 4,016 and 6,005 species, respectively, in the well-respected Howard & Moore checklist (Dickinson & Remsen 2013; Dickinson & Christidis 2014). Thus, del Hoyo & Collar chose to recognise overall 943 more species, sometimes as a result of different responses to taxonomic works published in peer-reviewed literature. However, a substantial measure of the discrepancy in totals is the result of del Hoyo & Collar attempting to apply an operational method governing use of morphological and vocal characters towards species delimitation (Tobias *et al*. 2010) to as many taxa as possible that were thought might require revision. Nevertheless, in common with other prior published works, del Hoyo & Collar chose to treat as species quite a number of taxa, e.g. among Procellariforms, that would not have "passed" the Tobias criteria for recognition. At least in some of these cases, they considered that the conservation benefits outweighed the negatives of recognising additional species, many of them breeding on oceanic islands at high risk from introduced predators. This fact directly contradicts GC's baseline hypothesis.

What might be surprising to readers of GC is that one of the co-authors of that operational approach (Tobias *et al*. 2010 [Collar]) and the just-mentioned checklist (del Hoyo & Collar 2014, 2016), has worked in international bird conservation for 40 years, with a special focus on the compilation of Red Data books. Furthermore, all of the other authors of the Tobias criteria are primarily avian ecologists or conservation biologists. The motivation for undertaking a revision of the taxonomy of the world's birds is clearly explained in del Hoyo & Collar (2014: 19–20): "*Given that conservation very largely takes the species as its unit of concern, and that the future of many taxa might in part depend on their recognition or not as species …, it has become increasingly frustrating to have to wait—frequently in vain—for authoritative decisions from other sources over whether form A or form B is a species or subspecies*". The del Hoyo & Collar checklist was developed in collaboration with BirdLife International, the body responsible for assigning IUCN threat categories to birds, and its taxonomy has been adopted in full by the same organisation. Furthermore, various legislative bodies have also quickly elected to work with this checklist, including the EU and the UN Convention on the Conservation of Migratory Species of Wild Animals. In other words, one influential bird conservationist had to some extent "lost patience" in waiting for the input of professional taxonomists and elected to "do it himself". The resulting taxonomic inflation (almost 10%) seems to have been of no concern at least to some conservationists.

We will not discuss here the quality of the taxonomy employed by del Hoyo & Collar (2014, 2016), which is unimportant in the present context, but, contradicting GC, it demonstrates that real conservationists, at least in ornithology, do not, of necessity, require stability. They demand more and better taxonomy and are, in fact, behind what GC consider taxonomic anarchy, as illustrated by their own diagram. It also illustrates that there is no

necessary polarization between conservationists and taxonomists. But it raises one important question: who, after all, is demanding stability?

Furthermore, still considering their example, authorities must understand the difference between online lists and genuine taxonomic revisions. Species lists are useful for some practical purposes (*e.g*. to stimulate the general interest of the public in citizen science programmes), but they are obviously unscientific and should never serve as the base (data matrix) for any kind of serious research (see Nemésio *et al*. 2014 for a specific case). GC base their conclusion on a comparison between some of these online lists and the Howard & Moore checklist. Appropriate sources of information are always taxonomic revisions produced group by group. It is more difficult, but authors really interested to produce robust science should do so themselves, or invite a taxonomist to assist.

Even if the GC example of Aves taxonomy was true, the use of anecdotal observations to draw general assumptions is quite dangerous. In the present case, other examples from vertebrate taxonomy could easily be used to contradict that claim. For example, fishes, which possess a strong conservation appeal, including for economic reasons, currently number 34,401 valid species as of 31 May 2017, of which 3,924 have been described in the last ten years (Eschmeyer & Fong 2017). Despite the increasing rate of species descriptions, fish taxonomy can in no way be termed "anarchic", because cases of conflict are relatively rare, probably due to the standards of excellence established by the ichthyological community. Therefore, before accepting the conclusions of GC, it is necessary to perform thorough research that attests to the solidity of their statements.

Concluding remarks

Ending their paper with the phrase *"Vagueness is not compatible with conservation*", GC threaten the credibility of conservation biology as a science. The evolution of all sciences implies the constant revision of concepts in an effort to make scientific discourse best reflect our understanding of the natural world, and this is also valid for conservation biology, which has debated which entities represent the best targets for protection for more than 30 years. The case is sufficiently complex that the Moritz (1994) paper on the importance of alternative management units (Evolutionary Significant Units and Management Units) to species has been heavily cited since its publication. This debate is crucial to resolve the problems highlighted by GC's paper, but these authors appear to avoid or ignore the maturity achieved by conservation biology, as exemplified by Avise (1989) who predicted that "*An up-dated taxonomy that includes input from molecular genetics should provide a firmer foundation for the proper recognition and hence management of biotic diversity… Management personnel will have to keep an open mind regarding the prospect of taxonomic revision, particularly in groups that have been problematic or poorly studied. Most systematists are well aware of the provisional nature of existing taxonomic assignments, particularly at the subspecies and species levels… Inevitably, conflicts will occasionally arise when multiple data bases are used to assess taxonomic and evolutionary relationships*."

In fact, part of this problem stems from the embarrassing fact that, contrary to its introductory statement, the zoological *Code* indeed partly infringes on the freedom of taxonomic thought and action in forbidding to name taxa at ranks below subspecies (*e.g*., variety or form). This precludes the possibility to include such taxa in Red Lists and official juridical text, unlike the case in botany. Such lower ranks could very well be used for such alternative management units. Both taxonomists and conservationists have so far proved unable to explore these possibilities, despite recommendations that they do so (Dubois 2006, 2011: 43–44) (see also Daugherty *et al.* 1990 and May 1990 for the emblematic case of the extinctions of tuatara *Sphenodon* populations, or Valbuena-Ureña *et al.* 2013 for the newt genus *Calotriton*).

Finally, it is important that taxonomists reflect on the permanence of this discourse in scientific journals. It is clear that it has no philosophical or factual consistency. Yet, it would be a mistake for us to believe the discussion is futile. Taxonomy is a complex and strongly empirical science. Particularly in groups of great visual appeal, as in the case of vertebrates, the taxonomist responds, on the one hand, to the simpler demand of the ordinary citizen to know what merits a name and on the other hand, to Popper, Peirce and the many other philosophers of science, who demand the difficult goal of deductibility. It endeavours to identify unique clades that represent hypotheses of discontinuity in a fluid and continuous world. It is backed by reasonability and historical process, rather than by the formal logic that is supposed to characterize other sciences (Raposo & Kirwan 2017).

Under this scenario, there are no alternatives other than to constantly seek to improve the theoretical quality of

our science and our discourse. This is part of the refinement of concepts important to the structure of our knowledge, as is the case of the concept of species, which taxonomists should acclaim as proof of maturity and not the opposite (GC's total misunderstanding of this was well tackled by Hołyński 2017).

As Kierkegaard (1841) remarked in the introduction to his "On the Concept of Irony with Continual Reference to Socrates": "*The observer ought to be an amorist; he must not be indifferent to any feature, any factor. But on the other hand he ought to have a sense of his own predominance—but should use it only to help the phenomenon obtain its full disclosure. Therefore, even if the observer does bring the concept along with him, it is still of great importance that the phenomenon remain inviolate and that the concept be seen as coming into existence [tilblivende] through the phenomenon*." For this, taxonomy requires time, work, academic recognition, positions, funding and historical balance, nothing more, or less.

Acknowledgements

The authors received research funding from the following agencies, for which they are deeply grateful: Fundação de Amparo à Pesquisa do Estado de São Paulo (Proc. # 2016/18963-8 to RS); Conselho Nacional de Desenvolvimento Científico e Tecnológico (Proc. # 312067/2013-5 to FAB) and Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (PNPD fellowship to GRRB).

Literature cited

Anonymous [International Commission on Zoological Nomenclature] (1999) *International code of zoological nomenclature. 4th Edition*. International Trust for Zoological Nomenclature, London, xxix + 306 pp.

Avise, J.C. (1989) A role for molecular genetics in the recognition and conservation of endangered species. *Trends in Ecology & Evolution*, 4, 279–281. https://doi.org/10.1016/0169-5347(89)90203-6

Bremer, K., Bremer, B., Karis, P. & Källersjö, M. (1990) Time for change in taxonomy. *Nature*, 343, 202. https://doi.org/10.1038/343202a0

Carvalho, M.R. de, Bockmann, F.A., Amorim, D.S., Brandão, C.R.F., Vivo, M. de, Figueiredo, J.L. de, Britski H.A., de Pinna, M.C.C., Menezes, N.A., Marques, F.P.L., Papavero, N., Cancello, E.M. & Crisci, J.V. (2007) Taxonomic impediment or impediment to taxonomy? A commentary on systematics and the cybertaxonomic-automation paradigm. *Evolutionary Biology*, 34, 140–143. https://doi.org/10.1007/s11692-007-9011-6

Crisp, D.J. & Fogg, G.E. (1988) Taxonomic instability continues to irritate. *Nature*, 335, 120–121. https://doi.org/10.1038/335120b0

Daugherty, C.H., Cree, A., Hay, J.M. & Thompson, M.B. (1990) Neglected taxonomy and continuing extinctions of tuatara *Sphenodon*. *Nature*, 347, 177–179. https://doi.org/10.1038/347177a0

del Hoyo, J. & Collar, N. (2014) *HBW and Birdlife International Illustrated Checklist of the Birds of the World. Vol. 1. Non-passerines.* Lynx Edicions, Barcelona, 904 pp.

del Hoyo, J. & Collar, N. (2016) *HBW and Birdlife International Illustrated Checklist of the Birds of the World. Vol. 2. Passerines*. Lynx Edicions, Barcelona, 1013 pp.

Dickinson, E.C. & Christidis, L. (Eds.) (2014) *The Howard and Moore Complete Checklist of the Birds of the World. Vol. 2. Passerines. 4th Edition*. Aves Press, Eastbourne, 752 pp.

Dickinson, E.C. & Remsen Jr., J.V. (Eds.) (2013) *The Howard and Moore Complete Checklist of the Birds of the World. Vol. 1. Non-Passerines*. *4th Edition.* Aves Press, Eastbourne, 461 pp.

Dominguez, E. & Wheeler, Q.D. (1997) Taxonomic stability is ignorance. *Cladistics*, 13, 367–372. https://doi.org/10.1111/j.1096-0031.1997.tb00325.x

Dubois, A. (1998) Lists of European species of amphibians and reptiles: will we soon be reaching "stability"? *Amphibia-Reptilia*, 19, 1–28. https://doi.org/10.1163/156853898X00304

Dubois, A. (2005) Proposed rules for the incorporation of nomina of higher-ranked zoological taxa in the International Code of Zoological Nomenclature. 1. Some general questions, concepts and terms of biological nomenclature. *Zoosystema*, 27, 365–426.

Dubois, A. (2006) New proposals for naming lower-ranked taxa within the frame of the *International Code of Zoological Nomenclature. Comptes rendus Biologies*, 329, 823–840.

https://doi.org/10.1016/j.crvi.2006.07.003
Dubois, A. (2007) Phylogeny, taxonomy and nomenclature: the problem of taxonomic categories and of nomenclatural ranks. *Zootaxa*, 1519, 27–68.
Dubois, A. (2011) The *International Code of Zoological Nomenclature* must be drastically improved before it is too late. *Bionomina*, 2, 1–104.
https://doi.org/10.11646/bionomina.2.1.1
Eschmeyer, W.N. & Fong, J.D. (2017) *Species by family/subfamily*. Califonia Academy of Sciences, San Francisco. Available from: http://researcharchive.calacademy.org/research/ichthyology/catalog/SpeciesByFamily.asp (accessed 20 June 2017).
Gaffney, E.S. (1979) An introduction to the logic of phylogeny reconstruction. *In*: Cracraft, J. & Eldredge, N. (Eds.), *Phylogenetic Analysis and Paleontology*. Columbia University Press, New York, pp. 79–111.
Garnett, S.T. & Christidis, L. (2017) Taxonomy anarchy hampers conservation. *Nature*, 546, 25–27.
https://doi.org/10.1038/546025a
Godfray, H.C.J. (2007) Linnaeus in the information age. *Nature*, 446, 259–260.
https://doi.org/10.1038/446259a
Hołyński, R.B. (2017) Taxonomy: should it remain a serious branch of science or be transformed into a formal game? *Procrustomachia*, 2, 11–13.
Kierkegaard, S. (1841) *The concept of irony with continual reference to Socrates; notes of Schelling's Berlin lectures.* Princeton University Press, Princeton, 222 pp.
Leone, C.A. (1952) Genetics: Lysenko versus Mendel. *Transactions of the Kansas Academy of Science*, 55, 369–380.
https://doi.org/10.2307/3625986
May R. (1990) Taxonomy as destiny. *Nature*, 347, 129–130.
https://doi.org/10.1038/347129a0
Minelli, A. (2000) The ranks and the names of species and higher taxa, or a dangerous inertia of the language of natural history. *Memoirs of the California Academy of Sciences*, 25, 339–351.
Moritz, C. (1994) Defining "Evolutionarily Significant Units" for conservation. *Trends in Ecology & Evolution*, 9, 373–375.
https://doi.org/10.1016/0169-5347(94)90057-4
Nemésio, A., Rasmussen, C., Aguiar, A.P., Pombal Jr., J.P. & Dubois, A. (2013) Nomenclatural issues in ornithology: the incredible controversy on the identity of a long overlooked Brazilian bird. *Zootaxa*, 3734 (2), 241–258.
https://doi.org/10.11646/zootaxa.3734.2.8
Raposo, M.A. & Kirwan, G.M. (2017) What lies beneath the controversy as to the necessity of physical types for describing new species? *Bionomina*, 12, 52–56.
https://doi.org/10.11646/bionomina.12.1.6
Thiele, K. & Yeates, D. (2002) Tension arises from duality at the heart of taxonomy. *Nature*, 419, 337.
https://doi.org/10.1038/419337a
Tobias, J.A., Seddon, N., Spottiswoode, C.N., Pilgrim, J.D., Fishpool, L.D.C. & Collar, N.J. (2010) Quantitative criteria for species delimitation. *Ibis*, 152, 724–746.
https://doi.org/10.1111/j.1474-919X.2010.01051.x
Valbuena-Ureña, E., Amat, F. & Carranza, S. (2013) Integrative phylogeography of *Calotriton* newts (Amphibia, Salamandridae), with special remarks on the conservation of the endangered Montseny brook newt (*Calotriton arnoldi*). *PLoS ONE*, 8 (6), e62542. [1–12]
https://doi.org/10.1371/journal.pone.0062542
Zachos, F.E. (2016) *Species concepts in biology: historical development, theoretical foundations and practical relevance.* Springer International Publishing, Cham, 220 pp.
https://doi.org/10.1007/978-3-319-44966-1